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(71) Applicant *(for all designated States except LS US)*: CROWN CORK & SEAL TECHNOLOGIES CORPORATION [US/US]; 11535 S. Central Avenue, Alsip, IL 60803-2599 (US).

(71) Applicant *(for LS only)*: CARNAUDMETALBOX PLC [GB/GB]; Downsview Road, Wantage, Oxfordshire OX12 9BP (GB).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: CLAYDON, Paul, Charles [GB/GB]; 35 Elizabeth Drive, Wantage, Oxfordshire OX12 9YA (GB). MAXWELL, Ian [GB/GB]; 62 Kidmore Road, Caversham, Reading, Berkshire RG4 7LX (GB).

(74) Agent: RATLIFF, Ismay, Hilary; Carnaudmetalbox plc, Downsview Road, Wantage, Oxfordshire 0X12 9BP (GB).

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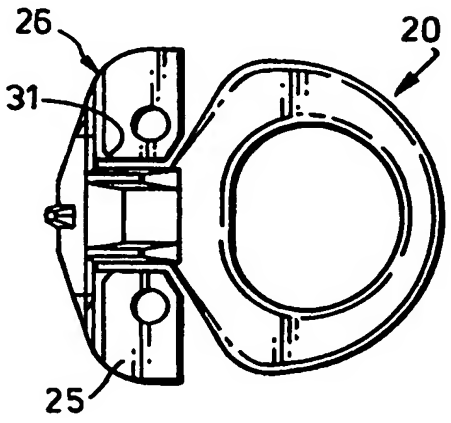
(54) Title: PLASTIC PULL TUB

(57) Abstract

A tab (20) for fixing to a can end having a circumferential score, is moulded from plastics material and comprises a handle, a stem and a nose. The tab is fixed to the can end by heat bonding wings (25) either side of the stem. By bonding the tab over large regions either side of the longitudinal axis of the tab, the end is forced to bend behind these wings, thereby creating a longer break in the score by simply raising the handle of the tab. The tab has hinges (26) between the wings and the nose which enable the tab to pivot easily without loss of tab rigidity.



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PLASTIC PULL TUB

This invention relates to a pull tab, in particular for fixing to an openable end panel of a container such as a metal can.

Tabs are well known for use in the packaging industry, especially in the so-called easy open end technology for beverage and food cans. Typically, such tabs are of metal, riveted to the can end, and comprise a handle which is raised to open the can end so that a nose portion breaks a line of weakness, or score.

A food can end of the "easy opening" type comprises a seaming panel, a chuck wall and a countersink joining the chuck wall to a central panel. A circumferential score is provided adjacent the countersink and a metal tab is riveted to the central panel so that its nose is positioned above the score.

In an easy open food can end having such a circumferential score, the nose of the metal tab pierces the score directly when the handle is lifted. Breaking the score takes place in three stages. Firstly, by lifting the handle, the score tears or "pops" as an initial arc is severed as the tab is lifted to the position where the tab is approximately 45° to the end. By pushing the tab over in a second action until it meets the peripheral chuck wall of the end, the initial score tear is propagated. In the third stage, the tab and end panel are pulled out away from the can body so that the end peels away from the can body. By breaking a greater arc in the second stage, usually defined in terms of the length of the chord joining the ends of the initial arc, the tear force required to remove the central panel in the final stage is reduced. However, the maximum chord length achievable may be dictated by various factors,

including the maximum tilting of the tab to meet the chuck wall.

According to the present invention, there is provided a tab of plastics material for fixing to and, in use, opening a metal can end, the end having a line of weakness extending around its perimeter, the tab comprising: a handle at one end of the tab for raising the tab away from the can end; a nose at the opposite end of the tab for breaking the line of weakness on the can end; and fixing regions comprising wings either side of the longitudinal axis of the nose and adapted to secure the tab to the can end; in which, in use, the distal end of the nose is adjacent the line of weakness and the remainder of the tab lies within the line of weakness; and the tab is secured to the can end solely by the wings.

The term "adjacent" is used to define a tab position such that the distal end (tip) of the nose will be directly over the line of weakness when the popping load is achieved. Depending on the tab design, "adjacent" could be directly above, inside or outside the line of weakness. Preferably, it will mean outside to allow for designs in which the tip of the nose moves back as the tab is lifted.

The tab of the present invention is thus particularly adapted for use in conjunction with a so-called full aperture end, in which the line of weakness, or score, extends completely around the perimeter of the end. Such an end has high opening force requirements. It has been discovered that by using a tab which is fixed either side of the nose, the initial lifting of the tab to pop the score and subsequent lifting to propagate this

tear, causes the centre panel of the end to hinge not only in front of the wings but also behind the wings. The production of this second hinge leads to an increase in chord length to a line projected across the rear edge of the wings after the second stage of opening, which line is considerably behind the line along which the tearing force is subsequently applied, and thereby leads to a decrease in peak tear force for complete opening of the can.

In a preferred embodiment, the wings are connected to the nose via two or more hinges and the nose is connected to the handle by a stem so that the nose and handle are pivotable with respect to the wings.

In a preferred embodiment, each hinge is defined by a region of minimum and substantially constant cross-sectional thickness, the region being a length l in the direction of the longitudinal axis of the tab, in which l is at least 0.3 mm, preferably at least 0.8 mm. This embodiment reduces the maximum strain in the material when rotating the tab without risking failure of the tab by hinge fracture. The value of l is selected such that fracture due to hinge failure will not arise before the score is popped. As l increases, the maximum tensile strain will also increase. However, l should not be so great that the tab distorts as described below.

Advantageously, this type of hinge comprises an inverted U-shaped channel, transverse to the tab, and the region of minimum thickness comprises the concave base of this channel; and hinging of the tab takes place in a first operation by pivoting about any transverse line over the concave base, thereby closing up the slot.

Ideally, the tab is moulded from a polymeric material for bonding the wings to the can end. This enables the entire area of the wings to be used to fix the tab to the end, which leads to stiff bond regions and further assists in the production of a second hinge. Using rivets instead of bonding would reduce the effectiveness of the second hinge. Where the tab is to be bonded to epoxy lacquer, the tab is preferably made from a material which is based on nylon 6 or polypropylene. An alternative polypropylene tab is preferably used in conjunction with a bonding coating such as "Morprime"™. The bonding method may vary according to the type of material used for the tab. The latter polypropylene tab may be bonded by welding, in which case the tab material is fuse bonded to the polypropylene content of Morprime™.

By moulding polymeric material to form the tab, the handle of the tab may be designed to give improved ergonomics over the more traditional metal tab. It is clearly advantageous to the consumer to have a tab which is bigger and smoother and easier to grasp for opening the container.

Generally the nose will include a downwardly extending beak which is blunt but as small as possible within the constraints of the material. For example, when the tab is of unreinforced nylons or nylon-type material (material which bonds like nylon), the beak has a preferred cross-sectional area at its tip of approximately 1 mm^2. This has been found to be the optimum size for the beak of this material to pierce the score without excessive compression of the beak. If the tab is made of reinforced material, this beak tip may be smaller. Alternatively, the nose may simply be angled

towards its tip such that the tip has a small contact area with the end in order to localise the applied load for popping the score.

According to another aspect of the present invention, there is provided a can end comprising: a metal panel; a line of weakness extending around the perimeter of the end which defines a removable portion; and a tab comprising a handle, a nose and wings either side of the longitudinal axis of the nose; the tab being intimately bonded to the metal panel solely by the wings, whereby raising the handle of the tab causes rupture of the line of weakness and subsequent folding of the panel behind the wings.

This can end may include a tab having any or all of the features described above.

According to a further aspect of the present invention, there is provided a tab of plastics material for fixing to a can end, the tab comprising: a handle; a nose; means for fixing the tab to an end panel; and one or more hinges for pivoting the tab with respect to the can end and fixing means; in which the or each hinge is defined by a region of minimum and substantially constant cross-sectional thickness, the region being a length l in the direction of the longitudinal axis of the tab, in which l is at least 0.3 mm.

As noted above, this type of hinge may comprise an inverted U-shaped channel, hinging of the tab may take place in a first operation by pivoting about any transverse line over the concave base of the channel until the slot is fully closed. In use, when the tab is fixed to the centre panel of a can end, the first hinging operation can be made at a low force without fracture.

However, once the channel has closed up, rotation is restricted and a second hinge line will be forced in the centre panel behind the first hinge. This increases the chord length achieved by propagating the initial score tear when the score is popped and thereby reduces the subsequent force required to remove the end panel.

Preferred embodiments of the invention will now be described, by way of example only, with reference to the drawings, in which:

Figure 1 is a first embodiment of tab in plan, side and front views;

Figure 2 is a plan view of a second embodiment of tab;

Figure 3 is plan and side views of a third embodiment of tab;

Figure 4 is plan, side and underneath views of a fourth embodiment of tab;

Figure 5 is a graph showing applied load and hinge angle for the hinge of figure 3b; and

Figure 6 is a graph showing applied load and hinge angle for the hinge of figure 4b.

Figure 1 shows a polymeric tab comprising a ring-pull handle 2, a stem 3, nose 4 and wings 5. The wings 5 are connected to the nose 4 by hinges 6, each of which comprises a slot as best seen in figure 1b. The wings 5 include holes 7 for riveting or otherwise attaching the wings onto a can end. However, it is possible to use other methods of fixing and ideally the wings may be bonded to the can end.

Where a heat seal is to be used to bond the tab to the end, clearly the material of the tab and any coating on the metal can end must be not only compatible but also

able to produce a strong bond which can withstand the forces exerted during opening of the can end. A tab for example of EMS Grilon nylon may be bonded to conventional epoxy lacquers. Where the can end comprises a laminate of polymer film and sheet metal, for example, more types of polymers may be used for the tab and still achieve a strong bond. Other lacquer systems may also be used which allow fixing of tabs of other polymers.

Not only must any fixing of the tab to the end be strong enough to withstand opening forces, but the tab itself must be sufficiently rigid to pierce a circumferential score on the can end without excessive flexing of the tab. The nose 4 terminates in a downwardly extending beak 8, see figures 1b and 1c. The beak 8 should be positioned as close as possible to the score. However, when using tab materials which have a low elastic modulus "E", the nose of the tab may bow transversely in a "humping" action. If this occurs then the effective hinge rises off the panel and the beak will move away from the score. Another problem with low E materials is torsion of the nose such that the hinge point moves closer to the beak, a higher pop force is required and the beak can rotate away from the score. The strength of the bond between the wings and the panel, and the hinge itself will oppose this torsion but if the hinge is too weak it will stretch and break.

The shape of the beak 8 is selected according to the material of the beak. For a nylon tab, the beak is as small as possible, typically about 1 mm^2 so that plastic compression of the beak as the tab is raised will not be so great that the beak contact area is increased and the beak is consequently unable to fracture the score. A

minimum pop force, which in turn minimises the debonding/deattaching forces on the tab is achieved with the sharpest possible beak acting as close as possible to the score.

For bonding to epoxy lacquer, a tab based upon nylon 6 is used. However, since nylon 6 absorbs water, there is a risk that the elastic modulus ("E") and the tab yield strength may be reduced simply by absorption of water from the atmosphere. With low E material, straining in the hinge area 6 and within the nose 4 will cause movement of the beak away from the score when trying to pop the score by lifting the tab, thereby resulting in failure to pop. In excessive cases the tab could be pushed completely over until it meets the chuck wall of the end without generating the force needed to pop the score.

These problems can be offset for example by the use of a polypropylene/nylon blend known as Orgalloy, which combines the water resistant properties of polypropylene with the ease of bonding of nylon. The tab should be as stiff as possible so that it does not flex to a degree which makes it incapable of popping the score. The presence of polypropylene in Orgalloy also limits the flexibility of the tab, although there should not be too much polypropylene or debonding of the wings becomes easier. Further improvements in tab rigidity can be made by the introduction of glass fibres, either in nylon 6 or Orgalloy. A preferred material for a polymer tab is Orgalloy reinforced with 30% glass fibre.

An alternative material is polypropylene reinforced with typically 30% glass fibre which is used in conjunction with a bonding coating. The glass content

provides stiffness to the tab. A suitable bonding coating contains anhydride modified polypropylene. One such coating is available under the trade mark "Morprime" and also includes an epoxy lacquer which further assists in bonding.

The stiffness of the hinges 6 determines the degree of hinging of the tab and panel at the hinges 6 in a first action when the score is popped and of the panel alone behind the wings in a second action during further lifting of the tab. The stiffness of the tab hinges 6 determines the operation of the second panel hinge. There must be a compromise between minimising the force required for initial popping of the score and minimising the peak tear force to remove the central panel.

The tab stem, nose and beak should be as stiff and rigid as possible while constrained by limitations on thickness and hinge flexibility. The wing width is also required to be a maximum for bond strength and rigidity. All these factors are limited by the tab thickness, which in turn is limited by the depth of the centre panel of the end beneath the seaming panel.

Alternative designs have been proposed as shown in figures 2 to 4. In figure 2, the wings extend further along the chord at the rear of the wings. This ensures that the second panel hinge behind the wings will be as straight as possible and limit any tendency for this hinge to deviate away from the straight chord, thus reducing the length of the popped score. The use of wider wings, however, requires more material for the tab and may also reduce the number of impressions which are available from a particular mould size.

Figure 3 therefore shows a tab 10 which, since it has narrower wings 15, enables more impressions to be made for the same mould size. Figure 3b shows detail of the design of the tab hinges 16. These hinges are similar to those of figure 1 since the wings 15 are thinner than those of figure 1, thus reducing material requirements. For both these embodiments which use a slot arrangement for the hinge, the tab will pivot about the thinnest part 9,19 of the hinge 6,16.

Example 1

A tab of EMS Grilon A28DZ nylon was moulded to form a tab as shown in figure 3. The elastic modulus of this material was 2200 Nmm^{-2} (in the dry condition). The tab was heat sealed to the centre panel of a 73 mm diameter can end coated with an epoxy lacquer. The score, which had a residual of 0.076 mm (3 thou) was popped at a force of 21 N. Subsequent tear force was 26.5 N.

Example 2

A tab as shown in figure 3 moulded from Orgalloy (a "blend" of polypropylene and nylon) having a modulus of 2000 Nmm^{-2} was bonded to a can end as described in example 1. The pop force required was 25.5 N and tear force 25.5 N.

Comparative Example 1

A metal tab riveted to a 73 mm diameter can end popped the 0.076 mm score at 20 N but required a tear force of 42 N.

It can be seen that the tabs of examples 1 and 2, moulded in accordance with the teaching of the present invention, have produced a reduction in tear force of nearly 40%.

A further embodiment of tab 20 which is bonded to a can end via wings is shown in figure 4. This tab has the same width of wings 25 as those of figure 3 but the hinges 26 are quite different. Each hinge is formed in the opposite manner to those of the other embodiments in that the hinge 26 comprises a slot 30 on the underside of the tab. The slot 30 has a concave "base" and the upper part of the hinge 26 is convex. A pivot region 29 which extends over 90° and over a length l, which is 1 mm in the direction of the longitudinal axis of the tab, thus has constant thickness. This reduces the maximum strain in the material for a given rotation so that the hinge can rotate further without fear of fracture. Any tendency for stress concentration is thus alleviated since the hinge can pivot about any part of the region 29. A further advantage of this hinge design is that "locking" of the tab as it closes up the hinge reduces the risk of fracture of brittle materials. The length l should not be too large as the force required to pop the score will increase as l increases and the tab may risk failure by humping or torsion.

When the tab has rotated to a position where the slot is closed up, the tab becomes more rigid and the force required for further pivoting along the tab hinge is severely restricted. This is beneficial to the production of a second panel hinge behind the wings since it easier to produce a second hinge in the panel than to continue pivoting about the first hinge. This design of

tab hinge has thus been found to be a major factor in the production of a second hinge and thereby an increased chord length by propagation of the initial score tear prior to the third stage of opening, and a dramatic reduction in tear force.

Example 3

Applied loads were measured at various angular deflections of the hinges for sample strips having the hinges of figure 3 (hinge 16) and figure 4 (hinge 26) machined on them. The results are shown in figures 5 (hinge 16) and 6 (hinge 26).

Figure 5 shows how the applied load increases as the hinge 16 is pivoted until the hinge angle reaches approximately 60°. At this angle, the tab material begins to fracture and the load drops rapidly until by about 75° the load is less than 5 N. A tab having this hinge would therefore be unlikely to be able to pop and tear the score.

In contrast, the hinge 26 of figure 4 when machined on a similar test strip provides a gradually increasing load until about the 85° position and at 90° the load is still greater than 15 N. A tab having this hinge would therefore be capable of popping and tearing the score when the tab is raised to the vertical (90°) position.

A further feature of the tab of figure 4 is a chamfer 31 at the inside front corner of the underside of the wings 25. This corner, where the stem 23 meets the edge of the hinge 26 focuses stresses which arise during the first stage of opening the can to which the tab is bonded. A 90° corner would therefore act as an initiation

point for peeling, i.e. debonding. By chamfering this corner, stresses are spread over a line rather than focusing on a single point. Peeling of the bonded region therefore requires more force than would normally arise when pulling the end away from the can body.

Another way to limit any peeling, if this is started, would be to use thicker material for the wings. However, since this necessitates greater material usage, it is preferred that designs are modified to prevent any peeling from being initiated in the first place.

Example 4

A tab having a similar design to that of figure 4 with the same style of hinge and a beak cross-section of 1 mm^2 was manufactured from polypropylene including 30% glass fibre. The tab had an elastic modulus of approximately 3500 Nmm^{-2} and used a Morprime™ coating for bonding to a 73 mm diameter full aperture easy open end. The score had a residual of 0.0775 mm. On raising the tab, the score was popped at a force of 23.2 N. Subsequent mean tear force was 28.5 N (27.7 to 29.6 N)

When using a polymer for tab manufacture, there are several factors which must be considered which are not relevant for a metal tab design. Although theoretically the tab design could be the same as that of a metal tab, when manufacturing from a polymer a longer hinge and a large bond line are required. Thus a polymer tab could have two stems and a central fixing region in the same manner as a metal tab but the fixing region for a polymer tab, which is bonded to the can end, would be wider than

the fixing region for a metal tab which is riveted to the end panel.

A further consideration for this tab design is the length of the polymer tab from the hinge line to the rear of the bond region which determines where the second hinge will be initiated. However, when the tab is bonded to the end panel only centrally, there will be a tendency for this second hinge to curve forwards, thus reducing the chord length which is popped.

The requirement for a polymer tab to have a longer hinge in comparison with that of a traditional metal tab is a consequence of the greater elasticity of the polymer tab. When a polymer tab is raised, the whole tab has a tendency to flex and the position where the beak applies pressure may move away from the score as noted above. As a result, the load which the tab beak applies to the score will vary according to the elastic modulus of the material used. Ideally the elastic modulus should be high (over 2000 Nmm^{-2}) for ease of popping the score. However, a smaller modulus is preferred to store energy in the tab so as to produce a long chord.

The present invention is described above by way of example only, the examples being directed to a polymer tab although metal tabs are still considered within the scope of the invention as defined by the claims. Clearly further modifications are possible depending, for example, on economics of material usage, forces required to open different diameter ends, method of fixing and different types of material.

CLAIMS

1. A tab of plastics material for fixing to and, in use, opening a metal can end, the end having a line of weakness extending around its perimeter, the tab comprising:

a handle at one end of the tab for raising the tab away from the can end;

a nose at the opposite end of the tab for breaking the line of weakness on the can end; and

fixing regions comprising wings either side of the longitudinal axis of the nose and adapted to secure the tab to the can end;

in which, in use, the distal end of the nose is adjacent the line of weakness and the remainder of the tab lies within the line of weakness; and

the tab is secured to the can end solely by the wings.

2. A tab according to claim 1, in which the wings are connected to the nose via two or more transverse hinges and the nose is connected to the handle by a stem so that the nose and handle are pivotable with respect to the wings.

3. A tab according to claim 1 or claim 2, in which the tab wings are bonded to the can end.

4. A tab according to claim 3, in which the nose includes, at its distal end, a downwardly extending beak which is blunt.

5. A tab according to any one of claims 2 to 4, in which each hinge is defined by a region of minimum and substantially constant cross-sectional thickness, the region being a length l in the direction of the longitudinal axis of the tab, in which l is at least 0.3 mm.

6. A tab according to claim 5, in which each hinge comprises an inverted U-shaped channel, transverse to the tab, and the region of minimum thickness comprises the concave base of this channel; and

hinging of the tab takes place in a first operation by pivoting about any transverse line over the concave base, thereby closing up the slot.

7. A tab of plastics material for fixing to a can end, the tab comprising:

a handle;

a nose;

means for fixing the tab to an end panel; and

one or more hinges for pivoting the tab with respect to the can end and fixing means;

in which the or each hinge is defined by a region of minimum and substantially constant cross-sectional thickness, the region being a length l in the direction of the longitudinal axis of the tab, in which l is at least 0.3 mm.

8. A can end comprising:

a metal panel;

a line of weakness extending around the perimeter of the end which defines a removable portion; and

a tab comprising a handle, a nose and wings either side of the longitudinal axis of the nose;

the tab being intimately bonded to the metal panel solely by the wings, whereby raising the handle of the tab causes rupture of the line of weakness and the panel to fold behind the wings.

Fig.1a.

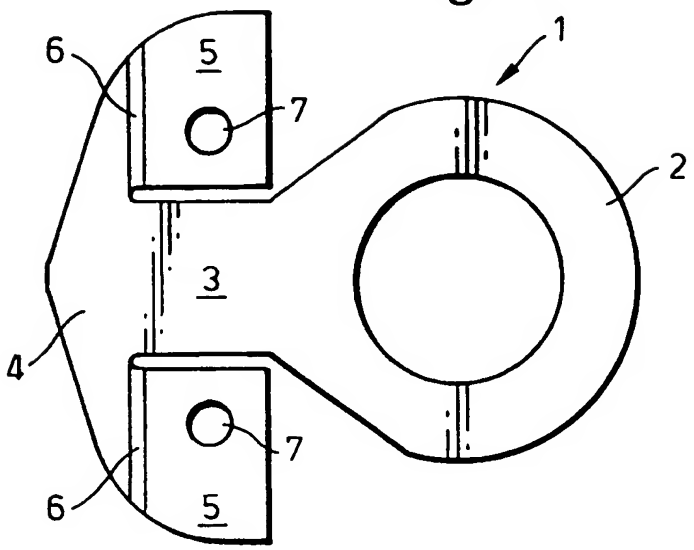


Fig.1c.

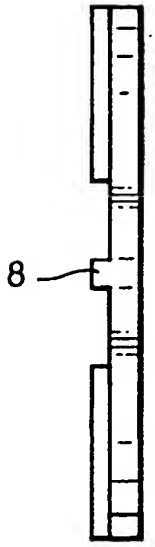


Fig.1b.

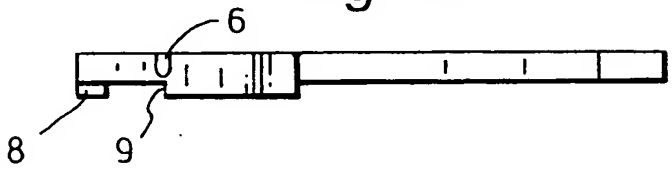


Fig.2.

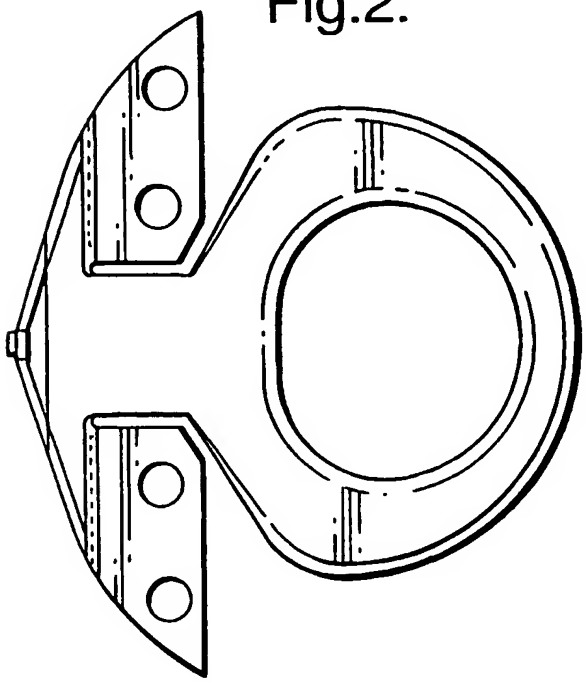


Fig.3a.

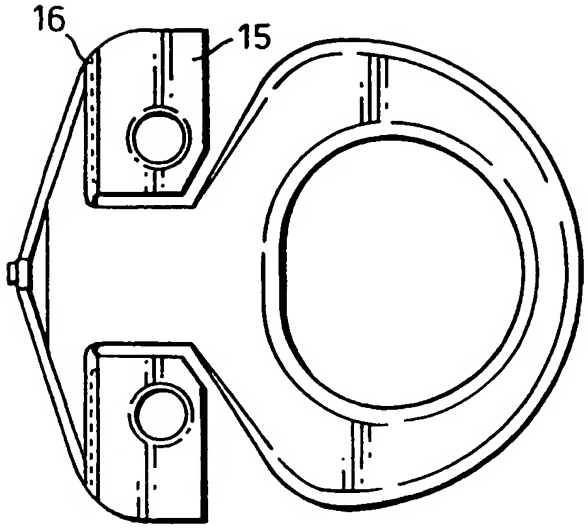


Fig.3b.

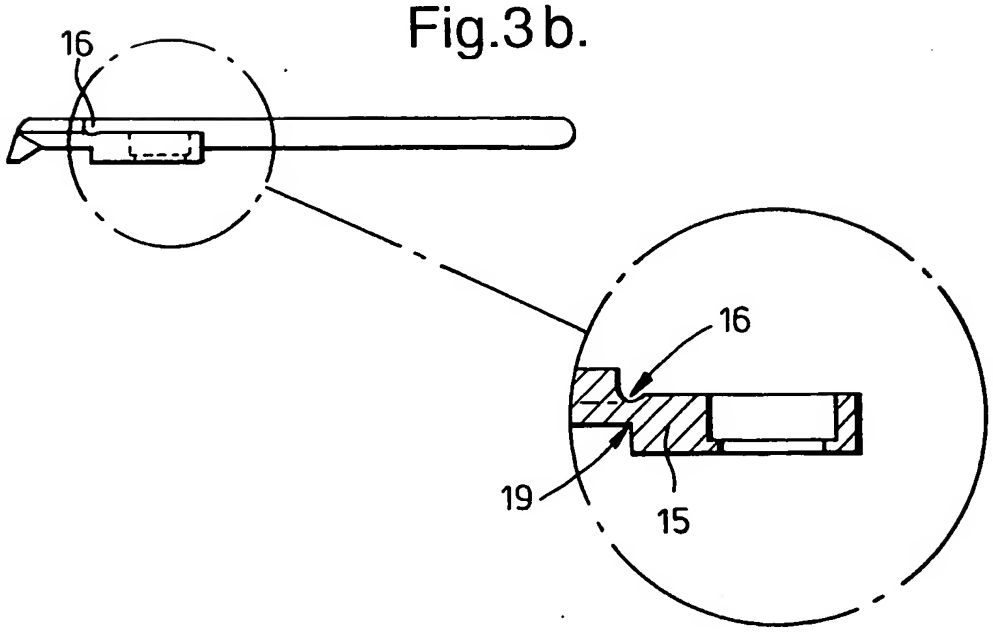


Fig.4 a.

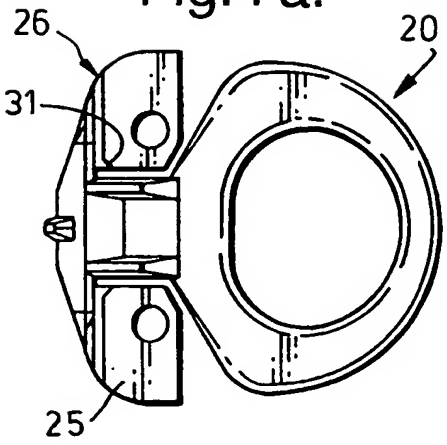


Fig.4b.

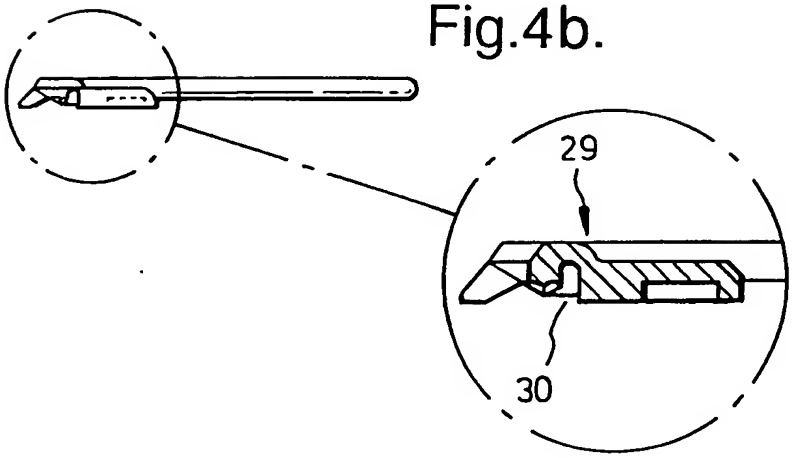


Fig.4 c.

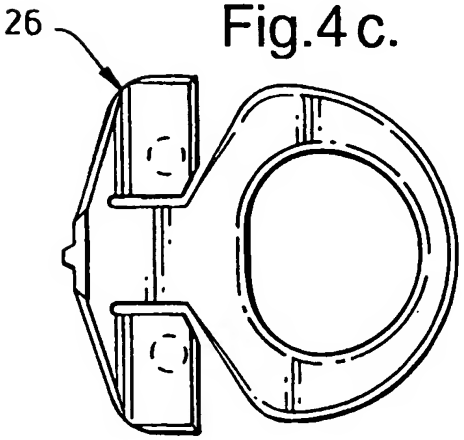


Fig.5.

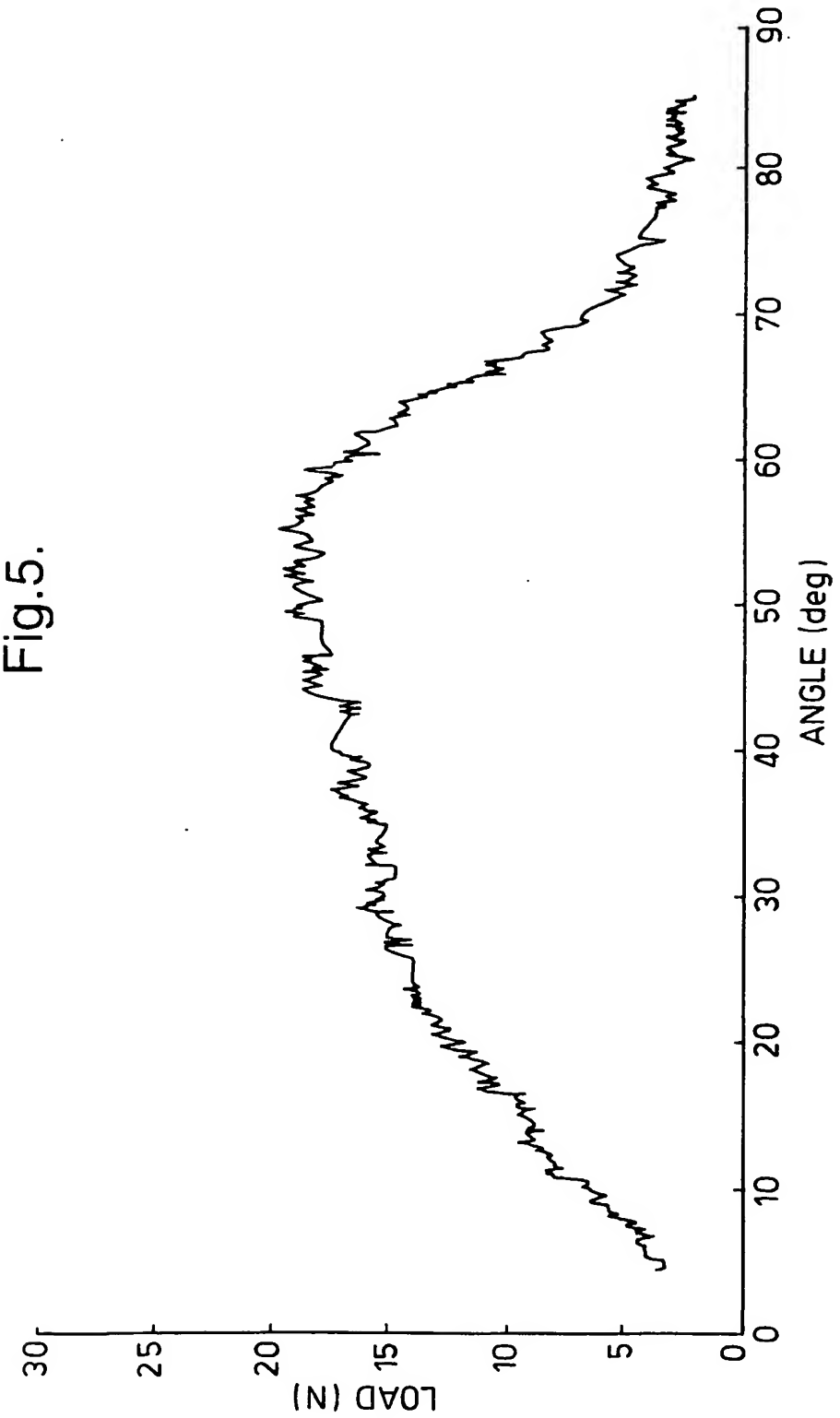
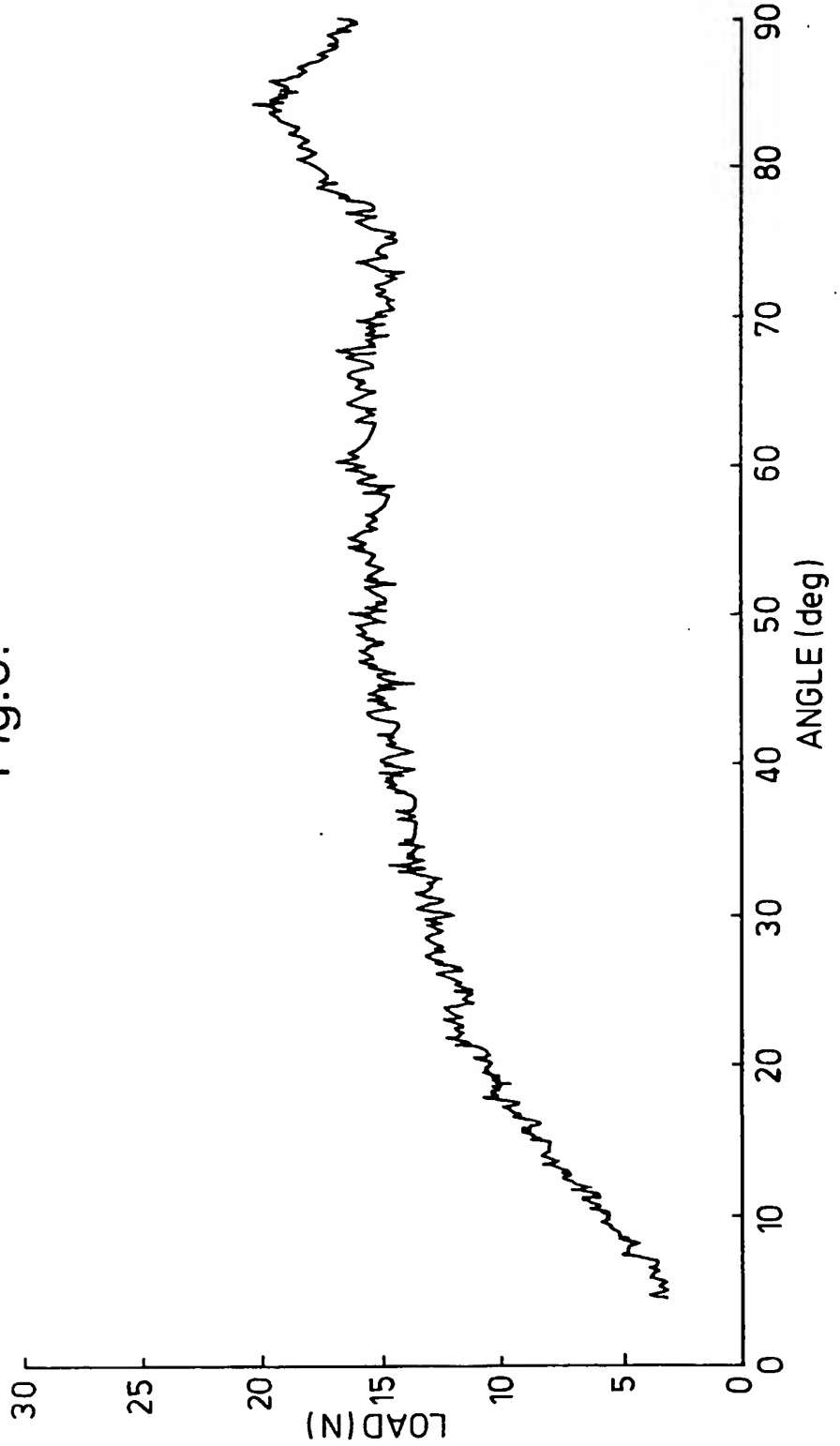


Fig.6.



INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 98/01550

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B65D17/34

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B65D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	EP 0 363 528 A (PROFOR) 18 April 1990 see the whole document	7 1-3,5,8
A	US 3 730 379 A (BROWN) 1 May 1973 see the whole document	1,2,4,8
A	US 3 432 068 A (FRAZE) 11 March 1969 see the whole document	1,8
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A	US 3 454 185 A (BROWN) 8 July 1969 see the whole document	1,2,4,8
A	US 3 625 392 A (KAMINSKI) 7 December 1971 see the whole document	1,2,4,8

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
18 August 1998	02/09/1998

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Leong, C

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 98/01550

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category '	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Information on patent family members

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